RESPONSE OF BROOMSEDGE TO SOIL FERTILITY AND LIME

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ABSTRACT

Former studies have indicated that broomsedge was a good competitor on old or abandoned sites with soils of low fertility. The influence of soil fertility and of lime were therefore tested in a noncompetitive situation to determine the direct effect of these factors on broomsedge development. A positive correlation was obtained between increases in soil fertility and broomsedge growth. Lime inhibited growth, however.

INTRODUCTION

Broomsedge (Andropogon virginicus) is an aggressive perennial bunchgrass native to the southeastern U. S. Since its introduction to Hawaii sometime prior to 1932 (Rotar, 1968), this species has rapidly established itself in dense stands in disturbed areas, particularly following fires, in Hawaii Volcanoes National Park (HAVO). Broomsedge persists for extended periods in a dry state, dominating the understory in open ohia-lehua forests, creating a major fire hazard which is not a natural component of native forests. A fire under these abnormal conditions may exceed the ability of native ecosystems to recover. For these reasons broomsedge invasion is considered one of the most serious threats by exotic plants in Hawaiian National Park Service areas (unpublished HAVO Resources Management Plan 1982 update).

Sorenson (1977) comprehensively summarized the literature concerning the known characteristics of broomsedge, which typified this grass as a common invader and dominant species in old or abandoned fields with low soil fertility on the U. S. mainland. The competitive ability of broomsedge under these conditions was such that this grass was frequently found to become established in almost pure stands a number of years following its invasion of old fields.

Peters and Lowance (1974) conducted tests in which the soil of an old field colonized by broomsedge was supplemented with nitrogen, phosphorus, and potassium fertilizers and lime. Seed of tall fescue grass was then sown as a competitor. After 4 years the tall fescue dominated the site and the broomsedge had almost disappeared, indicating that high fertility was disadvantageous to broomsedge under these competitive conditions.

The experiment reported here was conducted to further evaluate the relationship of soil fertility and pH on the development of broomsedge. The ultimate objective was to discover possible approaches through which the competitive

ability of broomsedge against native Hawaiian species may be diminished. It was therefore desirable to know whether these soil factors may be manipulated, particularly at the advancing margins of broomsedge stands, to the disadvantage of this exotic grass.

MATERIALS AND METHODS

To test the hypothesis that soil with higher fertility would be disadvantageous to the growth of broomsedge, soil was collected from an area on windward Oahu which supported little plant growth, indicating low fertility. The soil was technically classified as the Kaneohe series, a member of the clayey, kaolinitic, isohyperthic family of humoxic tropohumults.

An analysis conducted by the University of Hawaii Cooperative Extension Service indicated an initial soil pH of 5.0 (moderately acidic), a trace (very low) phosphorous level, and a potassium level of 40 lbs./acre (also categorized as very low). Although the level of available nitrogen was not determined, this factor was likewise obviously low.

Treatments were established in large pots in the greenhouse as follows:

Treatment	Soil Ammendment (all amounts are expressed as grams per cubic foot of soil. An asterisk denotes the approximate pounds per acre equivalent).
Low fertility	0.5 g urea (N); 108* 0.58 g treble super phosphate (P); 125* 0.4 g muriate of potash (K); 86*
Medium fertility	1.0 g urea (N); 216* 1.13 g treble super phosphate (P); 250* 0.8 g muriate of potash (K); 172*
Medium fertility plus lime ($CaCO_3$)	Same as medium fertility, plus 22.7 g lime (Ca); 4,008*
High fertility	2.0 g urea (N); 432* 2.25 g treble super phosphate (P); 500* 1.6 g muriate of potash (K); 344*
No fertilizer or lime added (control)	--

The fertilizers were thoroughly mixed into the soil prior to planting and seeds collected from broomsedge plants in HAVO were sown at the rate of 25 mg of seed per pot. The experiment included three replications of each treatment.

Plants were measured and photographed after approximately 80 days when variations in growth were most apparent, after which fresh shoot weights were taken.

RESULTS AND DISCUSSION

Differences among treatments were highly visible, but the growth rate of broomsedge was found to be in direct, rather than inverse, proportion to the levels of soil fertility. The soils with lower fertility supported meager growth, whereas growth was luxuriant in the high fertility soil (Fig. 1). Therefore, although broomsedge may be capable of favorable competition under conditions of low soil fertility, increases in fertility do not appear to be directly detrimental to the growth of this species in a noncompetitive situation.

A striking result of this experiment was the contrast between the medium fertility treatments amended and nonamended with lime. The lime treatment strongly inhibited the growth and development of broomsedge as observed after 80 days. The mean fresh weight of the nonlime-treated grass shoots was 17 g and that of the limed shoots was 1.3 g (Fig. 1).

The results of this experiment, and those reported by Peters and Lowance (1974), indicate that liming combined with fertilizer treatment may be effective in limiting the competitive advantage of broomsedge in field situations. This possibility has yet to be tested under field conditions in HAVO in relation to native species and ecosystems, however. Also, incorporation of amendments into the soil prior to planting, as was done in the greenhouse tests reported here is generally recognized as a more efficient treatment method than is applying fertilizer or lime to the soil surface among already-established plants as would be necessary in the field. Field testing is therefore necessary for a reliable evaluation of the effectiveness of this approach to broomsedge control.

LITERATURE CITED

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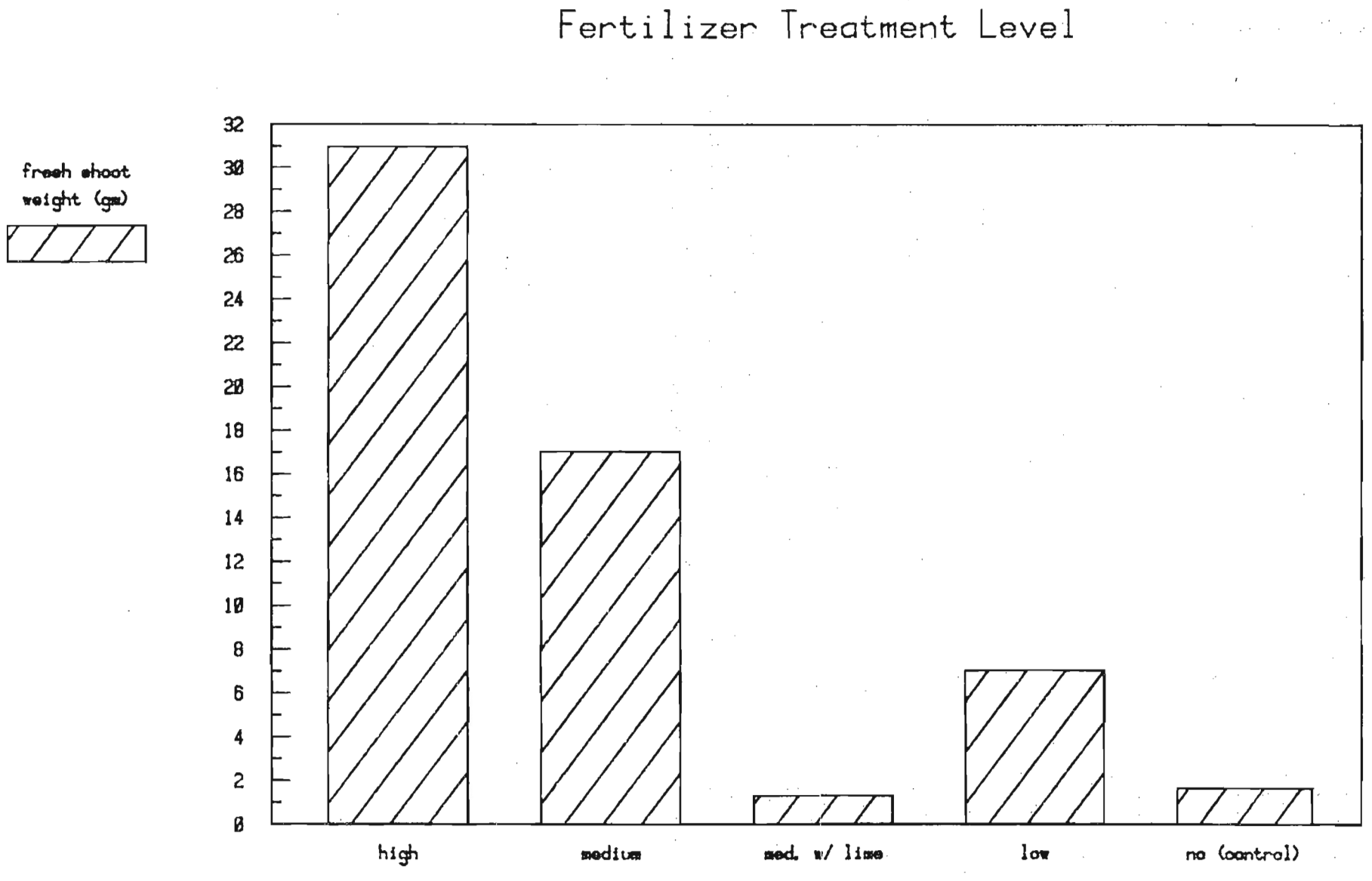

Fig. 1. Growth of broomsedge under various fertilizer and lime treatments